Chapter Three

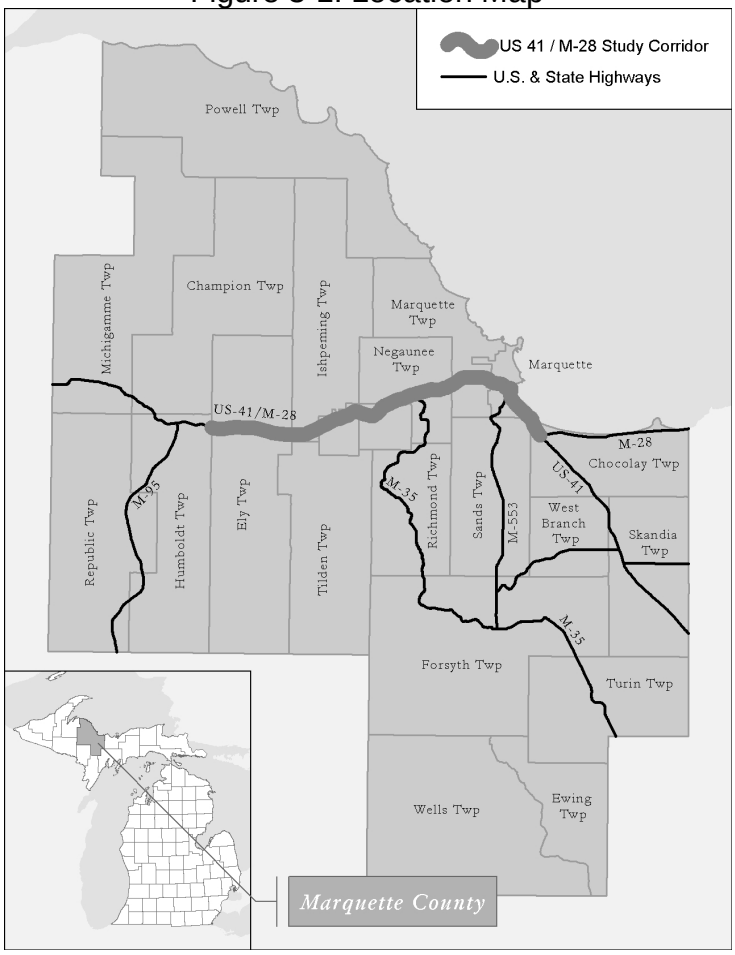
ROAD DESCRIPTION, PROBLEM AND OPPORTUNITY ANALYSIS

Introduction

This chapter gives an overview of the physical, as well as traffic and safety issues associated with the US-41/M-28 corridor. The study area for this Plan extends about ¾ mile either side of US-41/M-28 from the western-most border of Ely Township to the junction of US-41 and M-28 in Chocolay Township, which is about twenty-eight miles in length.

US-41/M-28 is classified as a state trunkline. It serves as the primary highway for local citizens in the region, but it also serves a thoroughfare for those traveling across the Upper Peninsula. See Figure 3-1.

Figure 3-1: Location Map



Corridor Roadway Description

Roadway Geometry and Speed

Beginning in the west, US-41/M-28 through Ely Township is a two-lane rural highway with a 55 MPH speed limit. The two-lane road continues as you travel east, through Ely Township into Ishpeming Township, at Westwood Drive, where the highway changes to four-lanes, and the speed also drops to 45 MPH going through commercial areas of Ishpeming Township. Continuing east, the 45 MPH speed limit increases to 55 MPH at the junction of North Lake Road within the City of Ishpeming and continues as a four-lane road. The speed limit changes to 45 MPH at Second Street east through the remainder of City of Ishpeming to the city's eastern border. The speeds increase to 55 MPH at the City of Negaunee western border but then drop to 45 MPH at Teal Lake Road in Negaunee through Iroquois Road in Negaunee Township when the speed increases to 55 MPH. US-41/M-28 goes from a four-lane to five-lane road with a turn-lane from Teal Lake Road to Iroquois Road in the City of Negaunee.

US-41/M-28 is a divided four-lane highway from Iroquois Road in the City of Negaunee east to M-35 in Negaunee Township. The speed continues at 55 MPH from Iroquois Road east into Marquette Township at the intersection of County Road 492. At the M-35 intersection the divided four-lane highway transitions into a four-lane highway with a paved median.

Within Marquette Township and the City of Marquette the speed limits change several times. At County Road 492 in Marquette Township the five-lane road transitions into a four-lane road with a median. The speed drops at CR 492 from 55 MPH to 50 MPH. The four-lane median continues east through Marquette Township and the City of Marquette to the intersection with Front Street. The speed limit drops from 50 MPH to 45 MPH at Days Inn in Marquette Township and stays that way until Washington Street where it increases to 55 MPH until near Front Street where it reduces to 50 MPH. At Front Street US-41/M-28 turns south, the speed limit drops to 35 MPH and the road continues as a five-lane with a center-turn lane. South of Hampton Street the road continues to be five-lanes, but the speed limit goes up to 50 MPH. The 50 MPH speed limit continues to Tonti Road. At Tonti Road the 55 MPH speed zone continues through to Chocolay Township where it is reduced to 45 MPH from the Welcome Center to the junction of US-41 and M-28.

Traffic and Safety Analysis

Volumes

According to MDOT, 24 Hour ADT Volumes for 2002, US-41/M-28 through Marquette Township has the highest traffic volume within the corridor study area, with close to 33,000 vehicles counted near Erickson Avenue. This area has the highest traffic volumes in the entire Upper Peninsula. To the west, average daily traffic volumes drop to 17,000 vehicles through Negaunee and 15,000 vehicles in

Ishpeming. West of Ishpeming, volumes drop to 11,000 vehicles. To the east, traffic volumes range from 15,000 vehicles between Washington Street and Front Street, then rise to 24,000 up to the State Prison, before falling to about 19,000 vehicles per day. (See Table 3-1 and Figures 3-2 and 3-3).

The traffic volumes for the US-41/M-28 corridor study area have shifted over the past five years; in some areas they have increased and others they have decreased. Volumes show increases over the past five years within areas in Marquette Township and the City of Marquette, although traffic volumes declined in other parts of the study area. In 1997, 33,900 vehicles were recorded on US-41/M-28 at Erickson Avenue. In 2002, the ADT volume count was 32,800, a 3% drop. Significant gains in traffic volume were recorded near the CR 492 intersection within Marquette Township, an increase of 26% over the past five years. This area has added several large retail establishments, which may account for much of the gains in this area.

Table 3-1: MDOT Annual Average ADT Traffic Volumes 24 Hour Counts

US-41/M-28 at:	1997	2002	Difference	Percent Change
Erickson Street, Marquette Twp.	33,900	32,800	-1,100	-3.24%
CR 492, Marquette Twp.	26,000	32,800	6,800	26.15%
S. of Division, City of Marquette	22,500	24,000	1,500	6.67%
Border of City of Marquette and Sands Twp.	20,400	18,900	-1,500	-7.35%
West of Teal Lake Road, Negaunee Twp.	17,600	17,100	-500	-2.84%
2nd Street, Ishpeming	17,000	15,300	-1,700	-10.00%
Between Grove St. and Front Street	14,200	13,500	-700	-4.93%
Ishpeming Twp-border of City of Ishpeming	9,900	10,100	200	2.02%

Source: MDOT, 2002

Figure 3-2: MDOT 2002 Average Annual Traffic Volumes in Marquette

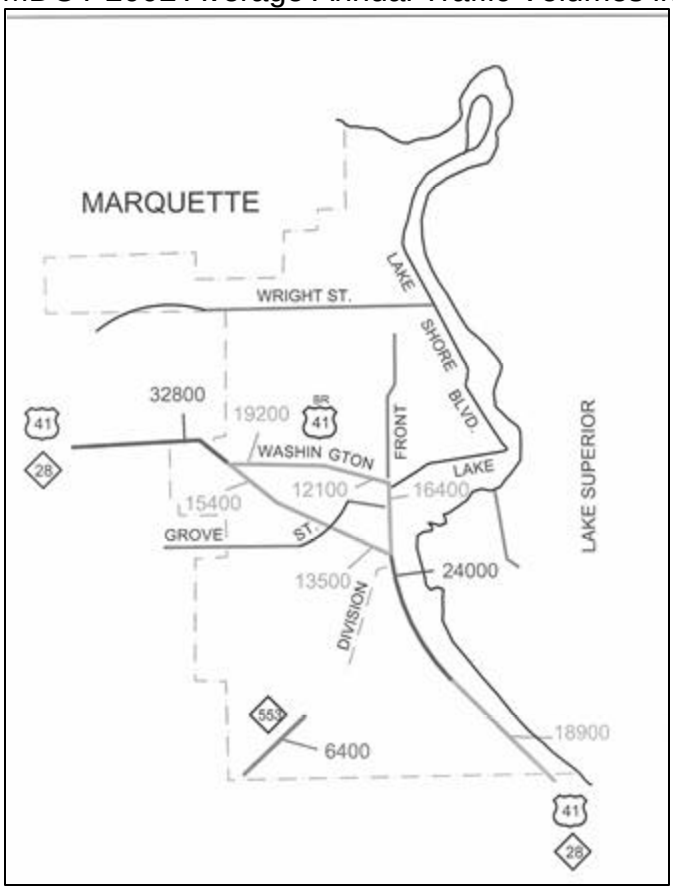
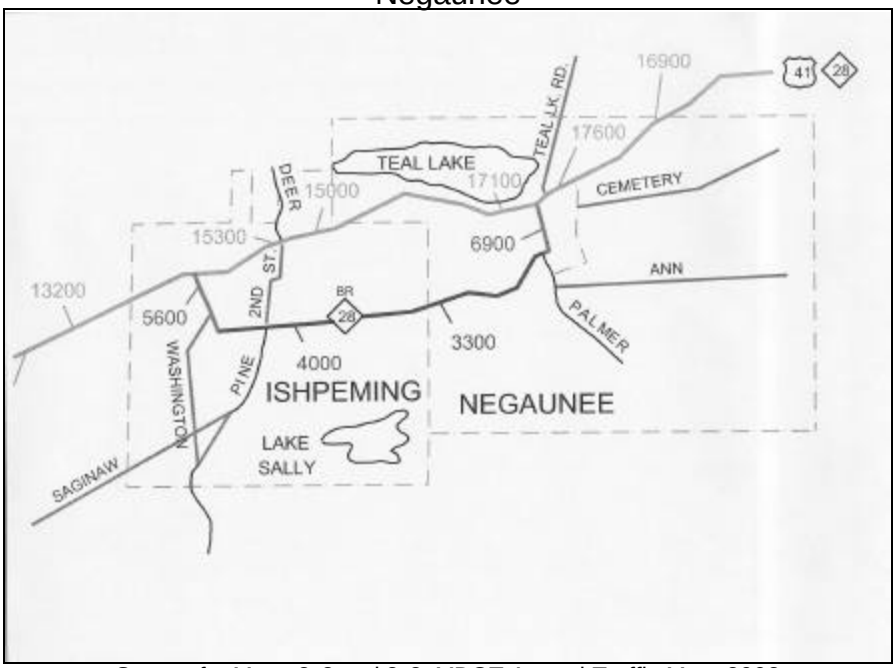


Figure 3-3: MDOT 2002 Average Annual Traffic Volumes in Ishpeming and Negaunee



Source for Maps 3-2 and 3-3: MDOT Annual Traffic Map, 2002

Crash Analysis

Crash analysis of the years 2000, 2001 and 2002 yielded the following top thirteen crash locations within the study area, based on data provided by MDOT. There is a brief description of the current geometry of each intersection along with the most frequent problems within the intersection. Detailed recommendations for these intersections will be addressed later in this Chapter and in Chapter 4. See Appendix B for detailed drawings of turning movements and crash patterns at each of the intersections.

1. *US-41/M-28 at Washington (in Marquette)*
   With 97 crashes over a three-year period, this intersection was the highest within the study area. Over 60 of the crashes were rear-end crashes on westbound Washington Street approaching US-41/M-28. This intersection is confusing especially for drivers not familiar to the area. See Photo 3-1.

   The geometry of this intersection is the most complex in the corridor. Both the east and westbound directions of US-41/M-28 are divided roadways. There are four lanes on the eastbound approach, two lanes for left-turns and two lanes for through-traffic. There are two through-lanes on the westbound approach with a right-turn lane under STOP control. The east leg of Washington Street is a divided four-lane roadway. The westbound approach has two lanes that must turn right at US-41/M-28. There is a channelized median left-turn lane for Meeske Avenue. Traffic turning from Meeske Avenue is also allowed to proceed through the intersection to US-41/M-28, under STOP control.

Photo 3-1: Washington Street and US-41/M-28

2. *US-41/M-28 at McClellan (in Marquette)*
There were 81 crashes at this intersection during the three-year period. The topography at this intersection is of concern. There are steep grades up to the intersection from the north that may cause sight difficulties, particularly in inclement weather. Baraga Avenue, a parallel local street to the north of US-41/M-28, is situated on a slope; it is only about 400 feet away from the US-41/M-28 and McClellan intersection. See Photo 3-2.

McClellan is currently a four-lane road at this point and US-41/M-28 is a divided four-lane highway. Left-turns are prohibited at this intersection and traffic is directed to turn around beyond the intersection at median openings on US-41/M-28.

Photo 3-2: McClellan Ave. and US-41/M-28 Intersection (20-foot Contour Lines)

3. *US-41/M-28 at Lakeshore Dr. (in Ishpeming)*
This intersection at Lakeshore Drive is located near the western edge of the City of Ishpeming and accommodates traffic from the Country Village shopping center on the northeast corner of the intersection. See Photo 3-3. For the three-year period the intersection had 40 crashes, 21 of which were angle crashes. There was one fatality in this intersection during this time period, the fatality occurred against another driver attempting to make a left-turn from Lakeshore Dr. Eighteen of the 40 crashes involved injuries.

The north and south legs of Lakeshore have two approach lanes including a 100-foot left-turn lane on the north leg and short 60-foot left-turn lane on the south leg. The posted speed on US-41/M-28 is 55 MPH in this area.

The speed limit on Lakeshore Drive is 25 MPH on the north leg and 35 MPH on the south leg. The high speeds in this area may contribute to the higher crash severity. This intersection had the only fatality in the study area during the time period and the highest number of injuries in the corridor study area.

Photo 3-3: Lakeshore Drive and Country Village

4. *US-41/M-28 at Front St. (in Marquette)*

The intersection forms a modified "T" with free flowing right-turn movements and channelized left-turn movements. The northbound to westbound left-turn movement must yield to the eastbound to northbound left-turn, even though the traffic volumes are substantially higher. The Champion Street Bridge spans US-41/M-28 on the west side of the intersection. See Photo 3-4.

The northbound approach has two through lanes and a channelized left-turn lane. There is a channelized left-turn merge lane on the north side of the intersection. The southbound approach has two travel lanes. See Photo 3-5. The eastbound approach has two lanes, one for left-turns and one for right-turns. The speed limit on the north and south legs is 35 MPH. The speed limit on the west leg is 55 MPH.

Twenty-two of the 35 crashes at this intersection involve two turning legs of the intersection, the northbound Front Street to westbound US-41/M-28 leg and the eastbound US-41/M-28 to southbound Front Street leg. There were three head on turn collisions in the three year study period. There were 12 rear-end crashes, which occurred in conjunction with turning

movements. The sloping topography and snowy or icy roads contributed to six rollover crashes in this intersection during the study period.

Photo 3-4: Front Street and US-41/M-28 Intersection

Photo 3-5: Front Street/US-41/M-28

5. *US-41/M-28 at Genesee (in Marquette)*

The north and south legs of US-41/M-28 (Front Street) are five-lane roadways with a center lane for left-turn. The intersection forms a "T". The west leg (Genesee Street) has two approach lanes, one lane for left-turns and one for right-turns. The intersection is controlled by a two-phase fixed-time traffic signal. See Photo 3-5.

There are pedestrian indications for crossing the south and west legs. There is a marked pedestrian crosswalk on the south leg that terminates in a flowerbed beyond the east curb line of Front Street. There is no marked pedestrian crosswalk on the west leg.

The South Rail Yard Development is currently under construction along the harbor on the east side of the intersection. The construction driveway is offset approximately 120 feet to the north of Genesee Street. When completed, the access road to the new development will be located at the intersection directly across from Genesee Street. A traffic signal study will soon be conducted to determine whether moving the traffic light from Genesee to Hampton is warranted for either safety or operational reasons.

Twenty-three of the 32 collisions at the intersections were rear-end crashes, nine of these occurred in the southbound Front Street approach and nine on the northbound Front Street approach. Approximately 36% of the rear-end crashes occurred on wet/snowy/icy pavement.

6. *US-41/M-28 at Second St. (in Ishpeming)*

The east leg of US-41/M-28 is a five-lane roadway with center lane for left-turn. The west leg of US-41/M-28 is five-lanes with a marked 125-foot long left-turn pocket marked at the intersection. The north and south legs of Second Street has two approach lanes, including a short 90-foot long left-turn lane on the north leg and a 70-foot long left-turn lane on the south leg. See Photo 3-6. The posted speed limit on US-41/M-28 is 45 MPH. The speed limit transitions to 55 MPH west of the intersection. The speed limit on Second Street is 25 MPH.

The intersection is controlled by a two-phase fixed-time traffic signal. There are no pedestrian indications and no marked pedestrian crosswalks. There were twelve rear-end crashes and seven head-on left-turn crashes out of 30 total crashes within the intersection. Eleven of the crashes resulted in injuries.

Photo 3-6: Second Street in Ishpeming

7. *US-41/M-28 at Grove (in Marquette)*

The east and west legs of US-41/M-28 are divided four-lane roadways with a channelized left-turn lane at the intersection. There are two approach lanes on the north and south legs of Grove Street, one lane for through traffic and one lane for right-turns.

Left-turns are allowed in all directions at the intersection because the median does not have sufficient width to provide median crossovers beyond the intersection to accommodate indirect left-turns. See Photo 3-7. There is a leading protected left-turn phase on US-41/M-28. Left-turns are not permitted during the through phase. The posted speed limit on US-41/M-28 is 55 MPH. The posted speed limit on south leg of Grove Street is 25 MPH. There are no pedestrian indications or marked crosswalks.

There were 23 crashes at this intersection during the study period. Fifteen of the crashes were rear-end crashes.

Photo 3-7: Grove Street in Marquette

8. *US-41/M-28 at M-28 Junction and Cherry Creek Rd (in Chocolay Twp.)*
US-41 (south leg) and M-28 (east leg) merge at this location. The north leg (combined US-41 and M-28) and the south leg of the intersection are five-lane roadways with center lane for left-turn. US-41/M-28 transitions to a two-lane roadway south of the intersection. The east leg (M-28) has a short 100-foot long right-turn lane marked at the intersection with a long taper.

The west leg (Cherry Creek Road) has three lanes at the intersection including a 150-foot long left-turn lane. Cherry Creek Road transitions to a two-lane roadway west of the intersection. See Photo 3-8. The posted speed limits are 45 MPH on the north leg, 55 MPH on the south leg, 45 MPH on the west leg, and 55 MPH on the east leg. There are no pedestrian indications or crosswalks at the intersection.

Observations reveal that the major turning movements at the intersection are the southbound to eastbound left-turn and the complementary westbound to northbound right-turn. Conversely the northbound to westbound left-turn volume is relatively light. Therefore the southbound through-right signal phase often operates simultaneously with the southbound left-turn phase. Of the 23 crashes at the intersection, 9 were southbound to eastbound left-turn collisions.

Photo 3-8: Cherry Creek Intersection in Chocolay Township

9. *US-41/M-28 at Erickson (in Marquette Twp.)*
Crash data at this site included only 2001 and 2002. This is a mid-block location where Erickson Avenue forms a "T" intersection with US-41/M-28. A directional crossover is located directly across from Erickson Avenue for eastbound traffic. Erickson Avenue is controlled by a STOP sign.

Photo 3-9: Numerous Driveways

Twenty-three crashes occurred at this intersection in the last two years (2001-2002). Half of the crashes were angle collisions, attempting a left-turn via the media opening. Thirteen of the crashes were on wet/snowy pavement. There is notable problem with driveway related crashes due to the numerous driveways and signs along this part of the corridor. See Photo 3-9 and 3-10.

Photo 3-10: Erickson Avenue in Marquette Township

10. *US-41/M-28 at Silver Creek Rd. (in Chocolay Twp.)*

The north and south legs of US-41/M-28 are five-lane roadways with a center lane for left-turns. The eastern leg of the intersection is Corning Street, while on the west the street is called Silver Creek Road. The access drive to the Township offices is only 75 feet from the intersection on Silver Creek Road. See Photo 3-11.

Eight of the 21 crashes were southbound rear-ends. The visibility of the southbound US-41/M-28 traffic signal may be a problem for drivers of trucks and busses because of the pedestrian bridge located on the north side of the intersection. There were five angle and four head-on left-turn crashes.

Photo 3-11: Silver Creek Road Intersection with US-41/M-28

11. *US-41/M-28 at Baldwin (in Negaunee)*

The east and west legs of US-41/M-28 are five-lane roadways with center lane for left-turn. The north and south legs of Baldwin Avenue has two approach lanes, including a short 80-foot long left-turn lane on the north leg and a 100-foot long left-turn lane on the south leg. See Photo 3-12. The posted speed limit on US-41/M-28 is 45 MPH. The speed limit on the Baldwin Avenue is 25 MPH.

There are pedestrian signal indications on all four legs of the intersection. There are marked pedestrian crosswalks on the east and west legs only. Thirteen of the crashes were angle collisions.

Photo 3-12: Baldwin Street intersection in Negaunee

12. *US-41/M-28 at Hampton (in Marquette)*

This intersection is approximately 400 feet south of the Genesee Street signal. Hampton Street is controlled by STOP signs in both legs. US-41/M-28 operation is similar to the Genesee Street description, except the north bound US-41/M-28 speed changes from 50 MPH to 35 MPH at Furnace Street (one block south of Hampton Street). See Photo 3-13.

The crash pattern is similar to Genesee Street except this intersection is NOT signalized. It is notable that four collisions occurred at the multiple driveways of a tire center. As noted with the Genesee Street analysis, a traffic signal analysis will be performed to determine whether to change the signal location from Genesee Street to Hampton Street.

Photo 3-13: Hampton Street Intersection

13. *US-41/M-28 at County Road 492 (in Marquette Twp.)*

Crash data at this site included only 2001 and 2002. The intersection of US-41/M-28 and County Road 492 (Wright Street) is controlled by STOP signs on County Road 492. There is a median cross-over on eastbound US-41/M-28 to service the left-turn movement from eastbound to northbound. Therefore, all traffic on the northbound and southbound approaches on 492 must turn right at the intersection. Northbound and southbound straight-thru traffic on County Road 492 is not permitted at the intersection. See Photo 3-14. Northbound approach traffic with travel destination to the north or west is supposed to use the median cross-over located 1,200 feet to the east of the intersection (i.e. at the Westwood Mall entrance). However, local sources indicate that it is fairly common for northbound traffic from CR 492 intending to continue northbound or westbound on US-41, to ignore the "Do Not Enter" sign. There is no physical barrier such as curbing to stop this movement. Similarly, southbound approach traffic with travel destination to the south or east must use the median crossover located 1,300 feet to the west of the intersection. Therefore the total adverse travel for each indirect movement is nearly one-half mile distance.

The southbound County Road 492 approach is marked as two lanes. However, southbound traffic queues in the right lane only and does not utilize the second (left) lane. The lane separation is confusing.

There are right-turn lanes on both the eastbound and westbound US-41/M-28 approaches to the intersection. The posted speed limit on Wright Road is 45 MPH. Analysis of the two-year crash data indicates mostly rear-end collisions. The geometrics of median crossover are substandard.

Photo 3-14: Marquette Township Mall Area

Other Intersections of Concern

US-41/M-28 and Target Drive/Wal-Mart

The intersection of US-41/M-28 and the Target Drive-Wal-Mart driveway serves as the primary access points to the Wal-Mart store located on the south side of US-41/M-28 and the Target store located on the north side. To date, there is not a high level of crashes at this intersection. The signal operates with separate left-turn phases for traffic on the eastbound and westbound approaches on US-41/M-28 (see Photo 3-15).

The westbound US-41/M-28 approach to the intersection has four lanes; one lane for left-turns, two lanes for thru traffic, and one lane for right-turns. The eastbound approach has three lanes including one lane for left-turns. Both the northbound and southbound approaches to the intersection have three lanes; one lane for left-turns, one lane for thru traffic, and one lane for right-turns. The speed limit on US-41/M-28 transitions to 55 MPH west of the intersection.

Once the connector from Wright Street/CR 492 to Target Drive is constructed, much of the traffic turning westbound on US-41/M-28 at Wright Street will divert to Target Drive and this intersection will become much busier (while that at Wright Street/CR 492 will go down).

Photo 3-15: Wal-Mart/Target Intersection

US-41/M-28 at Median Crossover at Westwood Mall (Kohl's)

The intersection of US-41/M-28 and the median crossover at the Westwood Mall (Kohl's) entrance-exit driveway is controlled by a traffic signal. The signal operates on an 80 second background cycle to maintain coordination with the traffic signal at Target Drive-Wal-Mart. The median crossover on US-41/M-28 services the left-turn movement from eastbound US-41/M-28 into the mall

entrance. The median crossover also services the U-turn maneuver from eastbound US-41/M-28 to westbound. However, it is confusing to know who has the right-of-way; those making the U-turn or those exiting the mall. See Photo 3-14 and 3-16.

There is a right-turn lane on westbound US-41/M-28 at the intersection. All traffic exiting the mall must turn right. The mall driveway is divided by a center median. The twenty-two foot wide southbound mall exit operates as two approach lanes to the intersection.

The driveway at Applebee's west of the mall entrance is right in front of a median crossover permitting westbound traffic to complete a U-turn. Traffic conflicts are created by the combination of the driveway and the crossover location which could be resolved by relocating the crossover east of its present location. See further discussion in Chapter Four.

Photo 3-16: Westwood Mall Traffic Signal (*) and Commerce Drive

US-41/M-28 and Commerce Drive

The intersection of US-41/M-28 and Commerce Drive forms a "T" and is controlled by a STOP sign on Commerce Drive. Since the center median on US-41/M-28 is closed at this location, all traffic on Commerce Drive must turn right at the intersection. There is a right-turn lane on westbound US-41/M-28 at the intersection. The posted speed limits are 50 MPH on US-41/M-28 and 35 MPH on Commerce Drive.

Commerce Drive connects to County Road 492 (Wright Street) to the north. One proposal in Chapter Four is to open the median and extend Commerce Drive southward to Brookton Road (see Photo 3-16). Under this proposal the existing traffic signal at US-41/M-28 at Westwood Mall (Kohl's) would be removed and a new signal installed at Commerce Drive. This in effect would provide a direct

route for straight-through traffic on County Road 492 and may also reduce response times for emergency vehicles.

Currently there are median crossovers on US-41/M-28 to the east and west of Commerce Drive. See Photo 3-16. If the signal were moved to Commerce Drive, a decision must be made as to whether left-turns would be permitted or directed to the median crossovers. The median left-turn lanes are currently formed opposite Commerce Drive. The location of the existing median crossovers does not meet the MDOT standard of placing crossovers 600 feet distant from a signalized intersection.

Commerce Drive is 36 feet wide (from edge of pavement). If two approach lanes are to be provided to operate under traffic signal control, the road must be widened. Further analysis of this option is presented in Chapter Four.

Preventing Driver Confusion as Source of Crashes

The following sections provide an introduction to some of the concepts that will be recommended for implementation on the US-41/M-28 corridor within Chapter Four. The concepts in this section outline methods to create a uniform treatment in road design to minimize potential conflicts between drivers.

Importance of Uniform Treatment

Intersections

The intersection treatment along the US-41/M-28 corridor varies from jurisdiction to jurisdiction, but also varies within each jurisdiction. For example, within the City of Marquette drivers go through several complex intersections. From Washington Street to Front Street, the geometric design of the intersections change four times and drivers, particularly if not from the area, may become confused by the variation in intersection treatment. Pavement markings especially need to be uniform.

Median Crossovers

MDOT has a history of median implementation to improve safety and capacity along highways. In 1996 in Michigan, there were 425 miles of median with directional crossovers on the state highway system. Crossovers have been constructed where the central median is at least 50-60 feet. Directional (one-way) crossovers have been utilized for left-turning vehicles; in most cases, left-turns are prohibited at the signal. Instead, drivers go through the intersection and make a U-turn across the median when traffic clears.

Median crossovers along the US-41/M-28 corridor vary between jurisdictions, similar to the intersections. Median widths vary, as do the length of "turn-around" lanes. Some median openings allow two-way crossover, while others are designed for one-way traffic. Median crossovers would benefit from a more uniform treatment across the entire corridor. Medians are effective ways to manage high-speed traffic, however, without a uniform design, conflicts and driver confusion occur. The next section will present some of the median options that could be considered.

Signage

Signage is an important element of traffic control. Uniform signage, that is the same type of signs that are placed in a uniform fashion at each intersection, provides important information to the driver on what to expect. This helps avoid driver confusion. Speed limit signs, STOP lines, pavement marking arrows, etc. placed in a uniform fashion across the corridor can help drivers see more easily where turning lanes are and where they are expected to stop. This helps avoid the confusion that leads to crashes.

Limit the Number of Driveways

Another key to keeping crash levels low is restricting the number, location and spacing of driveways along the US-41/M-28 corridor. Numerous driveways along a corridor can cause driver confusion as drivers struggle to figure out exactly which driveway they need to turn into. The most basic fact associated with access related traffic crashes is that more driveways along a roadway result in more crashes. Driveways create conflicts between vehicles on the roadway and vehicles entering or leaving the roadway. Research shows that the more driveways per mile the higher the crash rate. See Table 3-2.

Table 3-2: Relationship of Driveway Density to Crash Rates

Driveways per Mile	Representative Crash Rate per Mile for a Multi-lane, Undivided Roadway	Increase in Crashes Associated with Higher Driveway Density
Under 20	3.4	-
20 to 40	5.9	+ 74%
40 to 60	7.4	+ 118%
Over 60	9.2	+ 171%

Source: MDOT Access Management Guidebook, 2001.

Average lot widths on both sides of a road would be about 225 feet at 40 driveways per mile and about 170 feet at 60 driveways per mile. This is substantially more than is common in some places along the US-41/M-28 corridor.

Whenever possible, communities and road authorities should limit the number of driveways per lot. This can be done through restrictions within the zoning ordinance and by using other techniques like shared access and connected parking lots. Recommendations will be made on this topic in Chapter Five.

Speed Progression

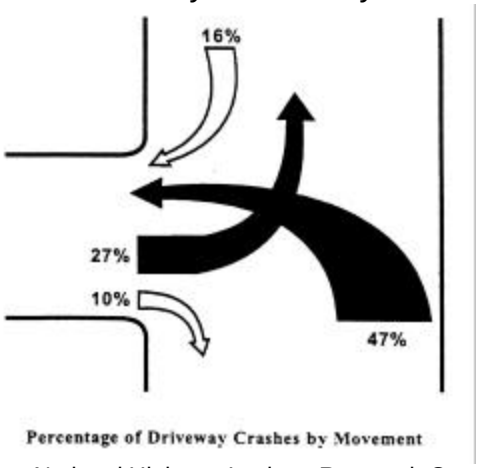
Poorly spaced signals hamper traffic progression. At least one-half mile between signals is typically desirable. Signals can provide the necessary break in traffic flow to permit vehicles to egress from properties lining the arterial. If signals are located too close, unnecessary traffic congestion can occur from through traffic which competes for road space with vehicles exiting driveways between signals. Irregularly spaced signals destroy the signal progression and therefore hamper traffic flow by increasing travel time and reducing capacity. Numerous driveways can also limit speeds because ingress and egress vehicles cause traffic to slow down.

Left-turn Movements

Many of the access management techniques focus on reducing the number of driveways and eliminating left-turn movements into driveways. Medians and restricting turns can reduce the number of left-turn crashes to and from driveways. This is important because nearly 75% of all access related crashes

are left-turns. See Figure 3-4. The left-turn movement into a driveway, without the benefit of a signal, accounts for 47% of the crashes associated with driveways. Twenty-seven percent of the crashes were turning left out of the driveway. Only 26% of driveway crashes are right-turns (with 16% in and 10% out).

Figure 3-4: Driveway Crashes by Movement



Source: National Highway Institute Research Center

Existing Land Use, Zoning and Future Land Use

The land uses chosen for a corridor can greatly affect the capacity, safety and operation of the roadway. Commercial development along a corridor can often be characterized by a long row of separate narrow lots with individual driveways to each business, sometimes called "strip commercial development." The large number of driveways which typically characterize this form of commercial development can result in increased congestion and traffic crashes because of the higher number of turning movements associated with commercial land uses compared to residential or other uses.

By planning and zoning for mixed uses along arterials, by clustering multiple commercial uses around a single access road and limiting driveways on arterials, commercial development can be accommodated without the attendant access management problems of strip commercial development. Mixed-use development might also link residential uses with commercial, so that people do not need to always use their car to go shopping. Mixed-use development could also provide office buildings with restaurants and shopping so workers could link potential lunchtime or after work trips. Linking day care establishments with office developments have been popular mixed-use developments which allows children to be near parents and reduces two daily trips from the roadway. Specific land use and zoning recommendations for the US-41/M-28 corridor will be introduced within Chapter Five.

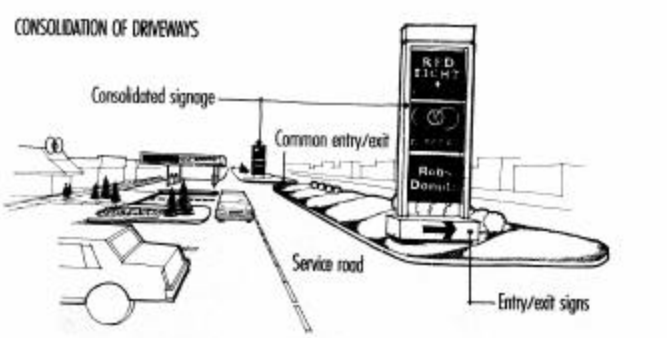
Environmental Features and Conditions

Environmental features, such as the topography of an area, can have an impact on the safety of a road. Slopes along US-41/M-28 were an apparent factor in some of the crashes along the corridor during the period studied, particularly in inclement weather. Intersections with significant slopes were of particular concern because adequate sight distance is very important at an intersection. Recommendations for individual intersections are presented in Chapter Four.

Scenic and Aesthetic Considerations

Typically improving signage, views and landscaping is thought of as an aesthetic improvement. But these improvements can also help improve safety on the corridor as well. Creating uniform signage for traffic and pavement markings can help driver orientation to the road, and simple, uncluttered signs for private businesses can also help improve driver safety. This involves establishing maximum height, area and location standards for signs. Also important is limiting the number of signs, which can be distracting to the driver. The consolidation of sign marques can provide a neater appearance as well as a safer corridor. See Figure 3-5.

Figure 3-5 Consolidated Sign



Source: Ontario Ministry of Municipal Affairs, *Design Guidelines for Highways and Commercial Areas*, 1985, p.23.

Community "Welcome" signs can provide the driver information on where they are, but they need to be placed in an area where they can be easily viewed, and if at all possible, should be located at a focal point of entry to the community where there are no sight distance problems.

Landscaping and street trees are very important to "soften" the built environment and reduce the amount of pavement. However, these plantings need to take into account the road right-of-way as well as sight distances in and out of driveways. See Chapter Five for specific recommendations for aesthetics on the corridor.

Capacity Improvements

Additional Lanes

Adding lanes is a traditional solution implemented by many local governments and road agencies facing traffic congestion. However, particularly in urban areas where there is a lot of development adjacent to a highway, implementing access management strategies is often more cost effective than adding lanes due to the extremely high cost of purchasing additional right-of-way, moving utilities, and relocating parking, signs and any structures. Widening often also results in businesses and homes being very close to the new lanes, causing sight distance problems for motorists and noise problems for residents and shoppers.

Yet, where traffic volumes warrant widening a road and adding lanes, the investment will be maximized by also consolidating driveways, installing parallel access roads, and implementing other appropriate access management techniques as a part of the widening project. The investment in added capacity should be protected by regulating the number and spacing of driveways that access the roadway.

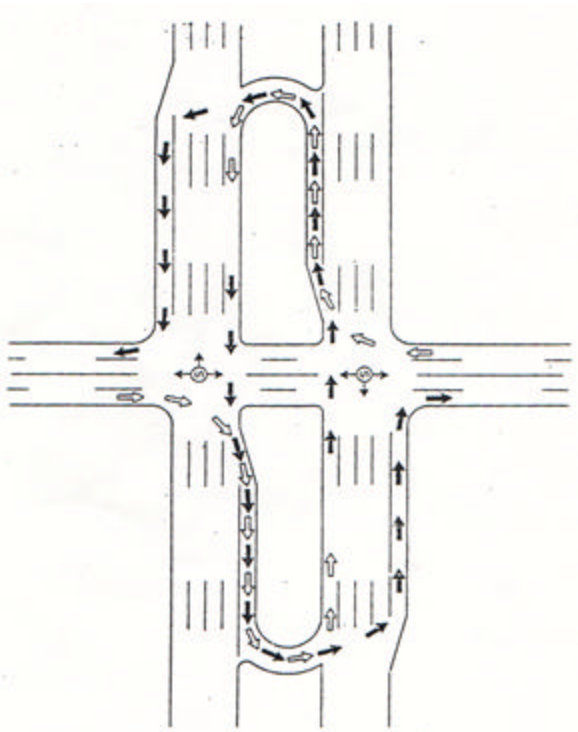
Boulevard Designs

Raised medians separate opposing traffic and reduce conflict points by eliminating left-turns into and out of driveways along an arterial. In fact, when properly designed, a roadway with limited median crossovers is the safest design with the maximum traffic carrying capacity. Medians are also effective at intersections to guide traffic while also separating it from opposing traffic. Separation allows for quicker turns and less traffic backups.

Standard Median

The standard MDOT 50-60 foot median requires about 270 feet of total right-of-way. The standard median design also does not allow left turns at intersecting roads. Figure 3-6 illustrates a standard Michigan median with an indirect left-turn. This is a safe design that has been widely copied around the world. Figures 3-7 and 3-8 illustrate example cross sections for four-lane median designs width with the necessary right-of-way required for each.

Figure 3-6: Indirect U-turn



Source: Levinson, Herbert, et al. "*Indirect Left-turns-The Michigan Experience*" for the 4th Access Management Conference, 2000.

Figure 3-7: Existing Cross Section for Four-Lane Road with Median

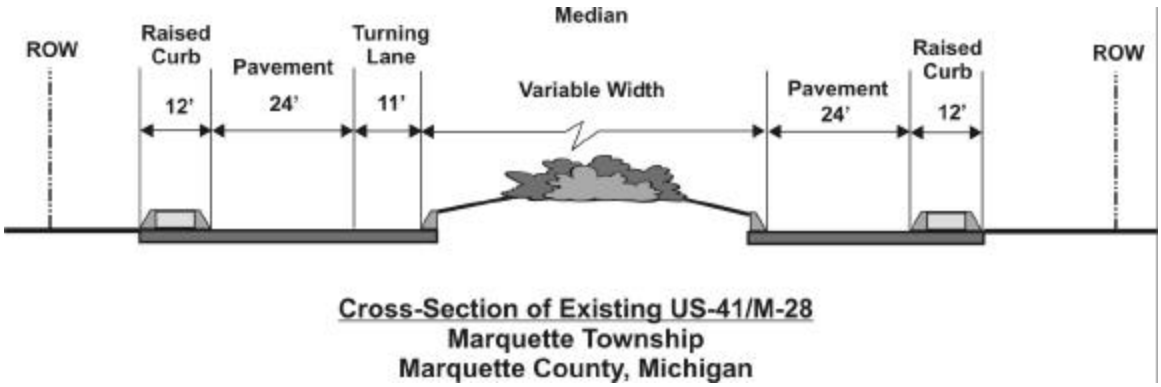
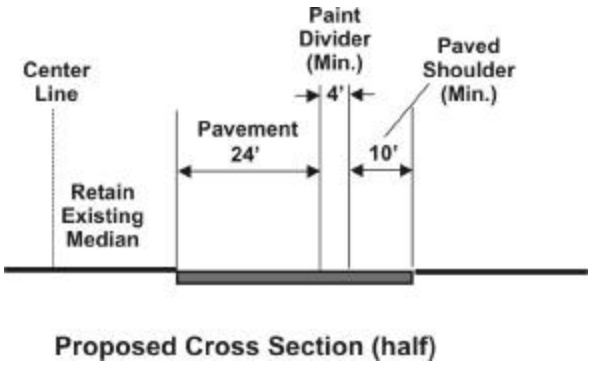


Figure 3-8: Proposed Half Cross Section for Four-Lane Road with Median



Narrow Width Medians

Narrow width medians, center islands that vary from 20 to 40 feet have been utilized in urban or suburban areas in Michigan where the right-of-way did not allow a standard median width. The narrow width median may require special turn-around lanes for trucks and buses because the narrow width geometry cannot adequately accommodate the large vehicles. See Photo 3-17 for an example.

Photo 3-17: Narrow Width Median on 44th Street in Kentwood

Source: Joe Pung, City of Kentwood, August 2001.

Roundabouts

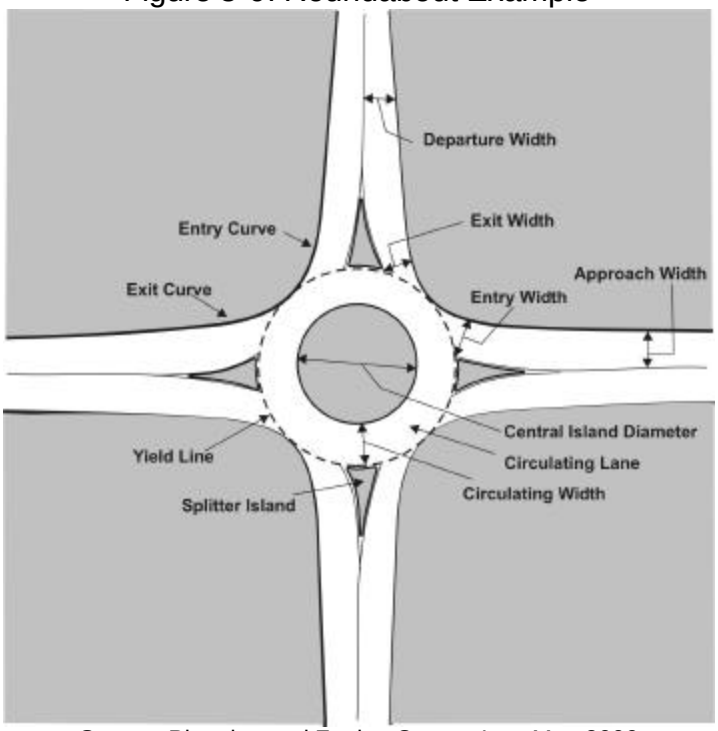
Roundabout intersection design within the City of Marquette has been discussed by city officials as a potential redesign for several intersections. Roundabout design has become more popular because of the safety benefits, better traffic progression, and because it can create an "entry" point to a community by creating a more interesting intersection design. They are also typically easy to maintain in the winter because the snow plows can turn-around so easily.

A roundabout is often used for intersections as an alternative to signalization. Roundabouts are designed with yield signs at entry points, which allow drivers to flow around the circle without stopping at a traffic light. Geometry of a roundabout is limited to speeds of 10-20 MPH within the circle. The diameter must be large enough to accommodate logging trucks and other large vehicles that commonly use the intersection. Roundabouts have been documented as safer than old traffic circles and traffic light controlled intersections because of the reduced number of conflict points from drivers making left-turns. *"The injury crashes are documented to be 35 to 78% lower than a typical signaled intersection. Overall, the average delay at a roundabout is estimated to be less than half of that at a typical signalized intersection."*[1] However, roundabouts typically require more space than a standard intersection and must have well designed approaches and exits to function properly. They are also expensive. See Figure 3-9. If a roundabout design was the desired preferred intersection alternative for any of the intersections on US-41/M-28 at which roundabouts are listed as an option, each such location would require a feasibility study to determine if the roundabout design could be achieved in a safe and cost-effective way that retained, if not improved, traffic flow (without decreasing level of service or causing additional user delay). If the analysis demonstrated feasibility and

[1] Jacquemart, Georges. *"Let's Go Round and Round,"* **Planning**, June 1996.

cost-effective results compared to alternative intersection designs with the same benefits, then the specifics of the roundabout design would be decided upon during the design phase.

Figure 3-9: Roundabout Example



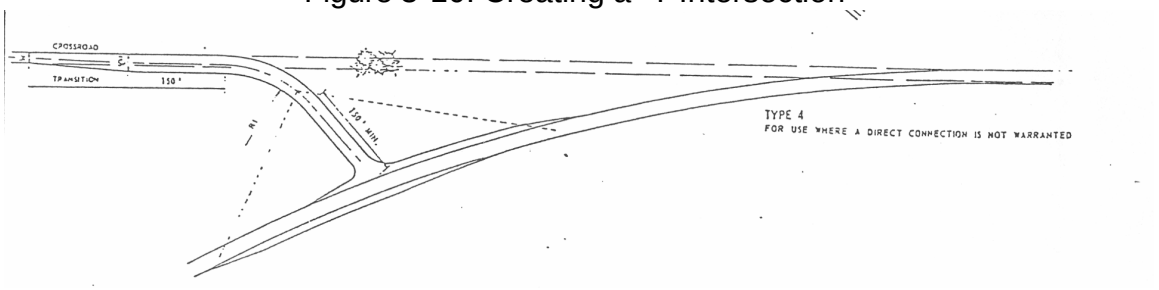
Source: Planning and Zoning Center, Inc. May 2000

Other Intersection Safety Improvements

Improve Turning Radius

Because there are many oblique intersections along US-41/M-28, and such intersections create visibility and safety issues for drivers, creating "T intersections" is a primary recommendation in Chapter Four. Creating a "T intersection" involves realigning the intersecting road so it is perpendicular to the main roadway. This allows for better, safer turning angles. See Figure 3-10.

Figure 3-10: Creating a "T Intersection"



Source: MDOT Traffic and Safety Note VII-640A "Turned-In Roadways" 2-4-91.

Right-turn Lanes

Right-turning vehicles can be removed from the arterial traffic with dedicated right-turn lanes. This allows through traffic to proceed without much slowing, preserving capacity and reducing the potential for crashes. MDOT guidelines suggest the use of right-turn lanes at any intersection where a capacity analysis determines a right-turn lane is necessary to meet a desired level of service. There are several recommendations for the construction of right-turn lanes at intersections within Chapter Four.

Access Management Improvements

This section provides a brief introduction to access management terminology which is used to describe recommendations within Chapter Four.

Close or Alter Driveways

A common problem along US-41/M-28 is properties with too many driveways. Sometimes there are three or four driveways when one well designed driveway is all that is needed. When there is not more than one driveway per parcel, and when driveways are properly spaced between properties, the roadway is safer, there are fewer crashes, and traffic flows better. As a result one of the most effective access management techniques is driveway closure and/or redesign. An existing driveway to a parcel can not be closed unless there will still be reasonable access provided in another way, such as from a shared driveway or, an alternative access point as for example, from the rear or side of the property. Closing driveways requires careful education of property owners and should be a key part of any plan to rebuild or expand capacity on a roadway.

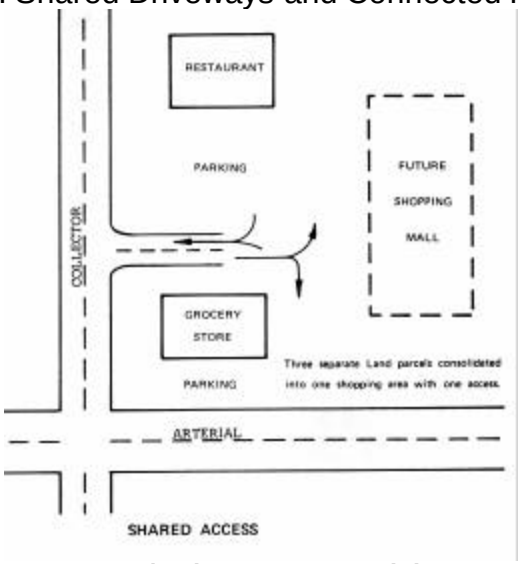
Driveway alterations can be a fairly inexpensive fix that provides a large benefit through reduction of crashes. Most commonly, driveway closures and alterations occur as part of a road reconstruction project, or when a property is proposed for redevelopment or new use. In these instances, site plan review is used as the process to ensure appropriate driveway design.

Combine or Consolidate Driveways

Close driveway spacing is a problem for two reasons: 1) for drivers turning out of adjacent driveways, competing for the same roadway; 2) for drivers that have to react to the turning movements from ingress and egress traffic at several points simultaneously. Consolidating driveways can remove a conflict point from the road and if the driveways are too closely spaced, consolidating driveways can result in the redesign of a safer driveway for both businesses. Figure 3-11 illustrates how driveways may link together. In Marquette Township, Red Lobster and Culvers Ice Cream have driveways so close together, they could easily be combined. Patrons frequently go in the “wrong” driveway because of the poor design.

Two or more adjacent properties can often share driveways and limit access points to an arterial. Sharing driveways is particularly valuable when lot frontages are narrow and alternative access is not available. In newer commercial developments, shared driveways are very common. Shopping plazas often provide one or two driveways for all the stores within them. Abutting shopping plazas can also often be linked together by connecting parking lots so that drivers can avoid exiting onto main arterials when going to adjacent properties.

Figure 3-11: Shared Driveways and Connected Parking Lots



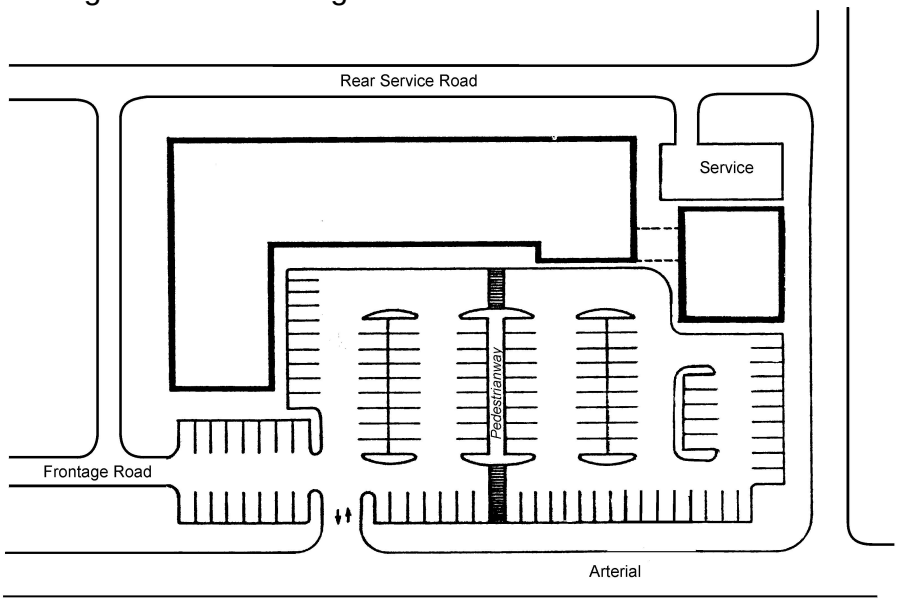
Source: *Arterial Street Access Control Study*, Tri-County Regional Planning Commission, 1981, p.24.

Frontage Roads and Rear Service Roads

Frontage roads and rear service roads can be utilized to keep traffic off of the main arterial. They can greatly reduce turning movements and direct traffic to collectors where a traffic signal can facilitate safer turns. However, frontage roads have come under some scrutiny, because they can create confusing turning movements, if used with high traffic generation uses. Adequate space may also be unavailable for a frontage or rear service road. Frontage roads can be most effectively utilized with low traffic generators like residential and small office uses or service uses like dental and eye care. Rear service roads can usually be designed to handle larger volumes of traffic.

Frontage roads or rear access between parcels can also aid connections between properties on a smaller scale. Rear access roads should be used whenever possible to more effectively move truck traffic around a commercial site and provide alternative access connections for automobile traffic between businesses. These connections can allow traffic to circulate between adjacent commercial properties without going onto the main arterial. See Figure 3-12 which illustrates how front and rear access drives work.

Figure 3-12: Frontage Roads and Rear Service Roads



Note: Rear access roads are usually safer and more effective than frontage roads and should be used whenever possible. Frontage roads should not be too close to the roadway or used where the volume of traffic is too great for safe vehicle use.

Improved Local Street Connections

Secondary streets can be a very effective means of access management when they function to keep local vehicles off of the main roadway. This requires an interconnected design with streets running parallel to the main road and intersecting streets at appropriate intervals. There are very few places along the corridor where this design exists and functions well. Chapter Four includes recommendations for extending local streets, particularly in areas where commercial development could be accommodated away from the arterial.

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C:/projectfiles2004/Marquette/marchplan/draftchapterthree2.doc
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